Removal of microcystins using portable water purification systems

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Introduction

Blooms of blue-green algae occurring in lakes and rivers are frequently toxic, producing a range of cyclic peptides known as microcystins. Extensive studies on toxicity and several toxicoses have led to a WHO guide line of 1 µg per litre in drinking water supply. Consequently there has been a large amount of research on the efficiency of water treatment processes to remove algal cells and toxins along with a range of management strategies.

Over recent years a number of portable water purification systems have been developed to meet the needs of recreational, military and emergency use. However, limited research on domestic and field purification devices has shown that few systems are able to remove microcystins to below the recommended level. As many lakes produce blooms, and an alternative water source may not be available, it is important to examine the performance of the portable purification systems.

In our study two systems were investigated, an MSR®Miniworks™ unit and a First Need® Deluxe from General Ecology both of which are claimed to exceed EPA requirements for removal of bacteria and protozoa. Both systems were evaluated for the removal of dissolved toxins and cyanobacterial cells.

Methods

Both filters were used and cleaned according to manufacturer's instructions. Micrcystin-LR (MC-LR) and the cell free extract of *M. aeruginosa* PCC 7820 which contained MC-LR, -LY, -LW and -LF were prepared as previously described (Lawton *et al*. 1995) and dissolved in tap and lake water to give realistic concentrations (50 µg l^{-1}) . Microcystins were extracted from water samples using solid phase extraction and analysed by HPLC as described by Lawton, *et al*. 1994. Removal of *Microcystis* cells was quantified using a particle analyser.

Results

Virgin filters removed 100% of MC-LR at a concentration of 50 µg l^{-1} from distilled water and lake water. Experiments were repeated where the water samples were spiked with the extract which contained MC-LR, -LY, -LW and -LF. Although systems performed well, the MSR no longer removed 100% MC-LR. Performance after cleaning was assessed and the MSR unit deteriorated, removing only 66.2-88.8 % of microcystin variants compared to 100% removal by the First Need unit.

The ability to remove whole cells was investigated, along with determination of intra- and extra-cellular microcystin concentrations. Both filters removed 100 % of cells but high concentrations of the microcystin variants were detected in the MSR filtered water, indicating that cells had been damaged and toxins released.

Conclusion

This short study demonstrated that the First Need filter was highly effective at removing both dissolved microcystins and cells, whereas the performance of the MSR filter rapidly declined, despite the fact that only 6 L of lake water had been passed though it and would therefore not be recommended such an application. More research is needed on continued use of the First Need filter to ensure that performance is maintained and there is no release of microcystins from trapped cells.

References

Lawton L.A., Edwards C., Beattie K.A., Pleasance S., Dear G.J. and Codd G.A. (1995) Natural Toxins. 3, 50-57.
Lawton L.A., Edwards C. and Codd (1994) Analyst 119, 1525-1530.